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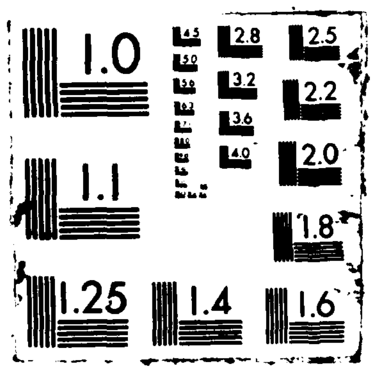
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D.O. 0001

SAIC-87/1581

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SAIC-87/1581

6 March 1987

Prepared

for

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Section 1
REPORTS

The following are reports that have been delivered under tasks 2(A), 2(B), and 3(B):

1) "Ambient Noise Directionality Estimation System (ANDES) Technical Description," by W.W. Renner, SAIC-86/1645, June 1986, UNCLASSIFIED.

2) "Ambient Noise Directionality Estimation System (ANDES) User's Guide (HP-9000) Installation," by W.W. Renner, SAIC-86/1705, April 1986, UNCLASSIFIED.

3) "Collected Materials from CNO (OP-006) Shallow Water ASW Prediction Review on December 11-12, 1985," by R.R. Greene, SAIC-86/1708, DCN-86:1195, March 1986, CONFIDENTIAL.

4) "Consodlidated BLUG Classes," by W.W. Renner and C.W. Spofford, SAIC-86/1955, November 1986, UNCLASSIFIED.

Section 2
TASK NARRATIVE SUMMARIES

2.1 TASK 2(A)

P.I.: A.I. Eller

2.1.1 LFA Support

SAIC efforts that were associated with the AEAS program in LFA support of distributed systems during FY86 were directed towards 1) identifying the driving environmental acoustic issues in connection with the activation of distributed systems, and 2) identification and evaluation of candidate models for propagation, reverberation and system performance.

These findings will be communicated to the sponsor in a separate report, "Modeling Support Requirements for Activation of Distributed Systems."

A program plan to meet these requirements has been put into effect, and a model to provide the needed support is scheduled for the end of the current fiscal year (FY87). The two primary modeling considerations that appear to drive the system performance, and thus also the selection of models, are the role of a range dependent environment and the decay of the direct transmission from source to receiver.

2.2 TASK 2(B)

P.I.: W.W. Renner

2.2.1 PE-BLUG Implementation

D. White developed an algorithm with which, given possibly discontinuous sediment sound speed and density profiles, the PE index of refraction can be smoothed and modified to provide reasonable bottom-loss values. E. Holmes implemented D. White's subroutines in the HP-9020 PE model and interfaced PE with the BLUG data base, which provides the sound speed and density profiles in the sediment layer.

The new PE-BLUG model was tested by subjecting the waterborne energy to an absorbing sponge, leaving only the single bottom-bounce energy in the problem. The transmission loss at a certain point in range and depth was then translated into an angle and bottom loss ($L(\theta)$). The angle versus bottom loss translation was compared to the BLUG loss versus angle curves. In cases where the density discontinuity was small, PE-BLUG modeled the bottom well. However, in many cases large density discontinuities caused PE-BLUG to exaggerate the bottom loss (as much as 10 dB per bounce).

Although PE-BLUG provides a convenient and automated connection to the BLUG data base, a better method for modeling the BLUG bottom is to convert BLUG parameters to $L(\theta)$ inputs for PE.

2.2.2 Range-Dependent Modeling Meeting

In early February 1986, acoustic modelers met to discuss and assess the current range-dependent models. The attendees from SAIC were:

Philip Rost	Mr. Rost discussed the PARKA data set and its comparisons with the PE model. He also described the HP-9020 PE model and provided timing estimates for PE on the HP 9020 versus the VAX 11-780 and the CRAY XMP.
Eleanor Holmes	Ms. Holmes described the Multiple Profile ray-trace program (MPP), its capabilities and limitations. She stressed that MPP is not an operational model, but contains features (such as CFIELD and uniform assymptotic expansion for intensity near caustics) that are necessary for proper TL computation.
Lewis Dozier	Dr. Dozier discussed the coupled mode code developed by himself and Allan Boyles from JHU-APL, and suggested that it could be used as an exact solution against which other models could be judged. The coupled mode model is presently much too slow to be used as an operational model.
DeWayne White	Mr. White presented ASTRAL and a preview of CZ-ASTRAL, two extremely fast models which provide range-averaged propagation loss.
Robert Greene	Dr. Greene summarized the capabilities of all the models previously discussed, and gave a short description of the work of D. White and E. Holmes on the PE-BLUG model.

2.2.3 Range-Dependent Model Evaluation

At the range-dependent modeling assessment meeting, it was decided that a range-dependent model evaluation would be held to determine which model would be the Navy standard desktop operational model. Candidates submitted by SAIC were PE-BLUG and CZ-ASTRAL. While Eleanor Holmes prepared PE-BLUG

for the evaluation, DeWayne White developed and prepared CZ-ASTRAL. Fred Tappert, Phil Rost and Eleanor Holmes prepared and submitted test cases. A combination of PE and ASTRAL, PAP (PE-ASTRAL Postprocessor), was submitted by PSI. PAP combined the waterborne, 25-Hz PE transmission loss, extrapolated to the frequency of interest, with the bottom-interacting CZ ASTRAL energy.

2.2.4 Rough-Surface Loss

Fred Tappert, from the University of Miami, worked at SAIC for the summer and developed an algorithm for implementation of an "ad hoc" rough surface in PE that would not increase running time by taking many tiny range steps (as do the more exact rough-surface algorithms in PERUSE and the PESOGEN Miami PE model). The algorithm was implemented, but did not provide enough loss to match data. A temporary, empirical correction factor was included in the rough surface formula, which seemed to provide satisfactory results.

2.2.5 SUBDEVRON 12

Eleanor Holmes delivered the operational PE-BLUG model to Keith Atkinson at COMSUBDEVRON 12. Keith was very pleased with PE's capabilities, and used the model in his data analysis. Fred Tappert and Eleanor Holmes spent a day at SUBDEVRON talking to members of the submarine fleet, who were quite predisposed to RAYMODE, a range-independent TL model. SUBDEVRON personnel, however, did show interest in PE's ability to both model the entire range-depth field and handle extremely range-dependent environments (e.g., a disappearing and re-appearing surface duct).

2.2.6 Ambient Noise Modeling

Final development of the Ambient Noise Directionality Estimation System (ANDES) was completed under Task 2(B). This effort included two tasks. For the first task a summary of the technical aspects of ANDES was prepared and presented in the technical report, "Ambient Noise Directionality Estimation System (ANDES) Technical Description," SAIC-86/1645.

The second task was to transfer ANDES from VAX 11/780 hardware to the HP-9020 computer. This involved reformatting the extensive environmental data bases and making numerous revisions to the software to account for machine dependencies. The post-processing plotting software was completely rewritten in order to use the DGL graphics library rather than DISSPLA software. Also prepared under this contract was the technical report, "Ambient Noise Directionality Estimation System (ANDES) User's Guide (HP-9020 Installations)," SAIC-86/1705, which describes how to install and use ANDES on the HP-9020. Finally, distribution of the model and documentation was made to several Navy labs and contractors.

2.2.7 Shallow Water ASTRAL

During this time the SAIC SASTRALB (stand alone ASTRAL with BLUG) code was transferred to the SAIC VAX computer at Campus Point. The theory of ASTRAL was examined to determine the best way to modify ASTRAL for better shallow-water predictions. In early February D. White attended the range-dependent TL meeting in Washington and presented a talk on ASTRAL. During this time the question arose as to the applicability of ASTRAL for range-dependent

modeling if CZs were required. Since some of the shallow-water work was directly applicable to this problem, it was thought that work on a Convergence Zone (CZ) ASTRAL might be appropriate. In mid to late March, the shallow water work was 'redirected' to include CZs and a surface duct capability (because of the nature of the problem in both the CZ and shallow-water model). It was decided that the computer code changes would allow the option of obtaining either the 'usual range averaged' ASTRAL or a CZ prediction. A trip by D. White to the SAIC McLean office for discussions with the originator of the model (C. Spofford), and further theoretical work by D. White, resulted in a method of converting SASTRALB to CASTRALB (i.e., ASTRAL with convergence zones, surface ducts and BLUG). The resulting code was implemented on the NORDA HP-9020 Navy desk top computer. Results of this work included a version of CASTRALB now presently available on NORDA's HP-9020, and a preliminary report on the model changes and required input to run the model (delivered to NORDA in early July). This code is still as fast as the original SASTRALB code for the same range sample size. After this delivery, work resumed on further implementations for a shallow-water ASTRAL. It appears at the present time that a different method of treating the frequency 'loop' in CASTRALB may be needed. In August a trip to NORDA was made for discussions with the sponsor on the status of current work. In these discussions, it has been decided that the Shallow Water, Convergence Zone, Surface Duct ASTRAL (to be referred to as ASTRAL 2.0) will continue to support multiple frequencies in the present manner for this year. Work continued on updating the ASTRAL code to obtain ASTRAL 2.0. Needed changes and the specific subroutines to be modified were identified and specific coding was started.

2.3 TASK 3(B)

P.I.: W.F. Monet

2.3.1 Geo-acoustic Modeling

Work under this task dealt primarily with geo-acoustic modeling of shallow water environments in the northern hemisphere (excluding the Arctic Ocean). This effort consisted of two tasks. The first task was to generate shallow-water bottom-loss provinces throughout the northern hemisphere similar to, and consistent with, the geoacoustic provinces existing in the deep-water version of the Bottom Loss Upgrade (BLUG). Preliminary provinces were created for the coastal United States and were presented at the shallow-water workshop held at Science Applications International Corporation (SAIC). This work was interrupted by a second task, the development and delivery of an environmental data base to be used with Colossus, a simpler shallow-water model presently in use by the Navy.

Colossus is a shallow water acoustic model that incorporates a binary environmental data base separated into shallow water provinces in the northern hemisphere. This data base was developed and delivered on magnetic tape to NORDA and the Navy.

Work on a complete shallow water geoacoustic model was resumed upon the completion of Colossus. This effort is to continue into the next calendar year with delivery expected in 1987.

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